Evaluation of Plants for Gully Stabilization
In the Florida Panhandle
Final Report

ABSTRACT

Gully erosion and downstream sedimentation are serious problems in the Florida panhandle. Plant materials are potentially a low cost alternative to controlling these problems. Nine species of plant materials were planted in four gullies in early 1994 and evaluated for five years. Overall plant performance was closely related to water volumes and velocities, which varied greatly between gullies. Vetivergrass (*Vetiveria zizanioides*), bitter panicum (*Panicum amarum*), marshhay cordgrass (*Spartina patens*), and brunswickgrass (*Paspalum nicorae*) all displayed good potential for use in gully plantings. Giant reed (*Arundo donax*) had fair performance in this study, but does have the potential of being invasive. Switchgrass (*Panicum virgatum*), maidencane (*Panicum hemitomon*), and limpograss (*Hermarthria altissima*) did not perform well on the sites they were planted on in this study. Sericea lespedeza (*Lespedeza cuneata)* isn't necessarily useful for soil stabilization. However, it does have good wildlife food value and can be included in a gully planting for that purpose.

INTRODUCTION

Soils in the Florida panhandle are typically composed of deep layers of sand overlain with heavy clays. These soil characteristics, coupled with sloping terrain and frequent intense rain events, make this region very susceptible to gully erosion. Unchecked, gullies can destroy thousands of acres of forest and farmland. In addition, the silt load carried by these gullies threatens wetlands and rivers down stream. Control structures can be built that capture sediment loads and limit erosion. However, these structures are costly to install and maintain. Plant materials, working in conjunction with control structures, have the potential of stabilizing critical areas and acting as living sediment filters, with less long-term expense.

Gullies are very difficult sites for plants to colonize. High velocity runoff makes physical establishment difficult. Topsoil, rich in nutrients necessary for growth, is usually missing. Soils are typically from the substrata, which have low fertility and a texture not conducive to plant growth. Plants adaptable to gullies must be able to establish quickly on infertile soils and overcome rapid sediment buildup. The purpose of this project was to identify plant materials capable of establishing and functioning successfully gullies. Selected species must not have the potential of invading adjacent sites and becoming a pest. For this reason, greater emphasis was placed on using native materials, or introduced materials, which were not known to be overly invasive.

MATERIALS AND METHODS

A variety of species were established in four gullies located in four counties in the Florida panhandle. Average annual precipitation for this region is approximately 60 inches. Each site was monitored for five years. On the final year, plant species were rated for survival and adaptability to the site, ground cover density, vigor, plant height and width, spread rating, and overall use in gully stabilization. The local district conservationists and PMC staff conducted the evaluations.

Anitoch Gully: Located in Okaloosa Co. on soils, which are predominately Lakeland sand. These are deep, excessively drained, rapidly permeable soils. A structure had been installed at the head of the gully to stop the headcut. The outlet pipe used in this structure was 18" in diameter and the structure had been designed to handle a flow of 20-cfs (cubic feet/second) as a 10 year, 24 hour storm peak. A fence structure was placed approx. 200' below the discharge pipe as an additional sediment trap. After one year, a basin began to erode under the opening of the outlet pipe. Rock riprap was placed in this area, which minimized subsequent erosion. Plant materials were established in the gully on 5/3/94. 'Sunshine' vetivergrass (*Vetiveria zizanioides*) was transplanted as plant propagules along the edges of the gully. Maidencane (*Panicum hemitomon*)('Halifax', FLPMC accession no. 421993 and 421992), 'Sharp' marshhay cordgrass (*Spartina patens*), and giant reed (*Arundo donax*), switchgrass (*Panicum virgatum*) ('Defuniak Source' FLPMC accession no. 9059616) were established in the gully channel vegetatively with plant propagules. 'Alamo' Switchgrass and sericea lespedeza (*Lespedeza cuneata)* were direct seeded by broadcasting in the channel. Almost 20" of precipitation fell in this area between May 1 and June 30 of 1994. Most of this moisture was received from very intense storm events shortly after planting. Several plants were washed out, so the site was partially replanted 6/27/94.

Obermeyer Gully: Located in Walton Co. on soils classed predominately as Lakeland sand. A structure had been installed at the head of the gully to stop the headcut. The discharge pipe used in this structure was 36" in diameter and the structure had been designed to handle a flow of 90 cfs as a 10 year, 24 hour storm peak. Plant materials used were'Sunshine' vetivergrass, switchgrass ('Alamo' and 'Defuniak Source'), 'Doncorae' brunswickgrass (*Paspalum nicore*), and sericea lespedeza. The vetiver and 'Defuniak Source' switchgrass were established by transplanting plant propagules. All other species were direct seeded by broadcasting. The site was planted on 4/21/94. Vetivergrass was placed on the upper edges of the gully and above the discharge pipe. All other species were placed in the main channel below the discharge pipe.

Ronald Rigby Gully: Located in Escambia Co. on soils, which are predominately Lakeland sands and Rustin fine sandy loam. A structure had been installed at the head of the gully to stop the headcut. The discharge pipe used in this structure was 48" in diameter and it had been designed to handle a flow of 180 cfs as a 10 year, 24 hour storm peak. A basin began to erode below the discharge pipe shortly after the structure was installed. An unsuccessful attempt was made to place rock riprap in this basin to minimize erosion. In this attempt, ruts were left along the spillway into the gully. These ruts channeled water and caused further erosion to the site. On 5/5/94, vetivergrass propagules were planted along the sides of the gully, above and below the discharge pipe. 'Halifax' maidencane and 'Redalta' limpograss (*Hermarthria altissima*) rhizomes were planted in the main channel of the gully along with sericea lespedeza, which was direct seeded.

Sandy Hollow Gully: Located in Santa Rosa Co. on well drained soils which are predominately Red Bay sandy loam and Orangeburg sandy loam. It has been classified as the largest gully in Florida. Reportedly, it is four miles long, up to 50 feet deep and 200 feet wide in places; and developed from a logging road in the 1940's. Plant materials were placed along a bend, where the bank is being eroded away. Three fence structures were installed to act as sediment traps. On 4/18/94, 'Sunshine' vetivergrass, giant reed, bitter panicum (*Panicum amarum*) ('Northpa' and 'Southpa') and 'Defuniak Source' switchgrass plant propagules were planted in rows perpendicular to the gully bank. 'Alamo' switchgrass and sericea lespedeza were direct seeded by broadcasting.

RESULTS AND DISCUSSION

During the five years of this project, the panhandle region was hit by several hurricanes and intense storm events. Annual rainfall at National Weather Service weather stations near each of the four gullies is shown in Table 1. Most years, the annual precipitation was well above the annual average of 60 inches. Excessive precipitation passing through the selected gullies provided a good opportunity to study plant performance under severe conditions. The success if these four gully stabilization projects varied according to the magnitude of flow and whether the control structures were functioning correctly. Adaptability of selected species is reported below for each site.

Table 1. Annual rainfall at weather stations near the four North Florida gully sites 1994 through 1998.

Site	1994	1995	1996	1997	1998
	(inches)				
Anitoch	100.93	83.84	*	*	*
Obermeyer	80.37	68.96	70.95	73.31	81.33
Ronald Rigby	75.7	75.3	65.43	64.86	66.61
Sandy Hollow	78.97	87.16	66.75	80.45	68.62

* Missing data

Anitoch Gully: Overall, this site had the lowest potential flow of the four gullies. Darryl Williams, Okaloosa Co. district conservationist, rated this gully as functioning successfully. Evaluation results of plant materials are shown in Table 2. Information shown includes the survival and size of each species; how much the plants had spread and colonized the site, and how effective they had been at this site in stabilizing the gully.

Table 2. Performance of plant materials at Anitoch Gully five years after planting.

Species	Survival	Height (cm)	Canopy Width (cm)	Spread Rating	Gully Stabilization
Vetivergrass	Excellent	100	78	Poor	Excellent
Giant reed	Average	300	78	Good	Good
Marshhay cordgrass	Good	93	21	Excellent	Excellent
Maidencane	Poor	62	27	Fair	Fair
Switchgrass	None				Poor
Lespedeza	Good	55	20	Good	Average

The banks of Anitoch gully were well vegetated and stabilized. The rock riprap under the discharge pipe had effectively minimized erosion at that point. The streambed was partially vegetated. This caused runoff water to be confined to narrower streams around the plants, producing some minor cutting in the channel bed. Maidencane was not growing at the locations where it had been planted. It was, however, growing down stream, likely having moved down with the runoff water. Switchgrass was initially found in this site but no plants were found after five years. One of the problems with using seed to vegetate gullies is that seedlings rarely have time to become established well enough to withstand heavy runoff. Lespedeza seedlings were vigorous enough to establish, but 'Alamo' switchgrass seedlings apparently were not.

Obermeyer Gully: Walton Co. District Conservationist, Terry Smith rated this gully as functioning successfully. All structures were functioning correctly, and plant materials had completely colonized the streambed. Plant performance at this site is shown in Table 3.

Table 3. Performance of plant materials at Obermeyer Gully five years after planting.

Species	Survival	Height (cm)	Canopy Width (cm)	Spread Rating	Gully Stabilization
Vetivergrass	Average	105	86	Poor	Excellent
Switchgrass 'Def. Spr.'	Poor	35	44	Poor	Poor
Brunswickgr.	Average	10	5	Average	Average
'Alamo'	Poor	123	107	Poor	Poor
Lespedeza	Good	67	75	Good	Average

Good populations of both switchgrass species were observed in the Obermeyer gully in 1997. Only a few plants remained by the time of the 1998 evaluation. The gully reportedly had been mowed in 1997. Switchgrass is extremely sensitive to mowing or grazing because of extended growth points in the tillers. It is possible that mowing before the switchgrass plants were dormant severely decreased plant populations.

Ronald Rigby Gully: Escambia Co. District Conservationist, Ken Collar rated this gully as not functioning successfully. Without the benefit of rock riprap, a huge basin had been eroded out in front of the discharge pipe. Water velocities were such that they had washed out most plant materials within several feet of the pipe. In addition, substrate in the stream channel was very poor, and the plant materials had difficulty becoming established. The ruts in the spillway had undergone severe erosion, and serious headcuts had begun to eat back up into the spillway. A tremendous amount of water flows through this gully at very high velocities. Plant materials were not able to colonize successfully on this site without the control structure also functioning correctly. Plant performance is shown in Table 4.

Table 4. Performance of plant materials at Ronald Rigby Gully five years after planting.

Species	Survival	Height (cm)	Canopy Width (cm)	Spread Rating	Gully Stabilization
Vetivergrass	Poor	130	96	Poor	Average
Limpograss	Poor	48	23	Poor	Poor
Maidencane	Poor	62	17	Poor	Poor
Lespedeza	Good	67	18	Average	Average

Vetivergrass planted on the upper slopes had been carried downslope by erosion, but were still actively growing. Where vetivergrass, maidencane or hermarthria had managed to grow in the main channel, water was forced around the plants. This reduced laminar flow and caused several deeper cuts to be formed in the streambed.

Sandy Hollow Gully: Steve Duncan, Santa Rosa Co. District Conservationist, reported a storm had dropped almost 13 inches of water on this region in March of 1997. This was one of many intense storms that pushed a phenomenal amount of water through this gully. The fence structure installed to catch sediment had been pushed down and silted over within the first two years. At the time of the final evaluation, only a few plants remained along the bank, with small remnants in the main channel. Performance of these remaining materials is shown in Table 5.

Table 5. Performance of plant materials at Sandy Hollow Gully five years after planting.

Species	Survival	Height (cm)	Canopy Width (cm)	Spread Rating	Gully Stabilization
Vetivergrass	Poor	72	52	Poor	Poor
Giant reed	Poor	100	52	Fair	Poor
Bitter Panicum	Poor	52	18	Fair	Poor
'Def. Spr.' Switchgrass	None				Poor
'Alamo' Switchgrass	Poor	96	52	Poor	Poor
Lespedeza	Poor	32	12	Fair	Poor

Bitter panicum, and vetivergrass were the only species remaining in the main channel. Vetivergrass clumps had been carried along by runoff water, and, if they did not become buried, they managed to continue growing. Bitter panicum was able to withstand some sedimentation. Under less severe conditions, it may have been able to colonize this area much more densely. A small remnant of giant reed had survived on the edge of the gully floor, though sediment deposits nearly smothered it. Despite the lack of success in this first planting at Sandy Hollow, Steve Duncan was positive about the role plant materials can play in stabilizing gullies, and he expressed a desire to try another planting at this site. In the future, it may be more profitable to take a holistic approach toward treating Sandy Hollow gully. Plant materials, land use and engineering practices applied to the watershed region around this gully could tremendously reduce the volume and velocity of runoff water passing through it. Once this is accomplished, plant materials and control structures would have a much better opportunity to stabilize soils and reduce the tremendous sediment load conducted by this gully.

To summarize, the overall performance of plant materials in these four gullies was closely tied to the volume and velocity of runoff water associated with each gully. Plants must function in two separate roles in gully plantings, stabilization and sediment filtering. The nine species considered in this study performed in these capacities with varying success.

Vetivergrass is a very long lived hardy bunchgrass that can withstand severe drought or wet periods. It has a dense, fibrous root system that makes it useful for bank stabilization. The roots cling tenaciously to the soil, and plants that had been washed downslope often remained alive and growing. However, once these plants gained a foothold in the streambed, they forced the water to route around them. This tended to confine runoff water and caused channels to be cut into the streambed. Overall, this plant can be useful in stabilizing upper banks of gullies. However, thought must be given to how the plants are placed in reference to the flow of runoff water. Impeding flow may actually increase the degree of erosion occurring. The vetivergrass used in this study, ‘Sunshine’, does not produce viable seed. This is advantageous in that this plant is not native to Florida, and doesn’t show any potential for becoming invasive. On the other hand, vetivergrass will not spread or colonize an area. Once a plant dies and is washed downslope, there is none to replace it. It should therefore be considered as an early succession plant that stabilizes the soil for colonization by other species. Consideration needs to be given to other species that will replace it.

Giant reed, because of its tremendous height and rhizomatous growth habit can withstand severe flooding and sediment deposition. It prefers moister soils, which limits it’s usefulness for bank stabilization. It does have potential as a sediment trap. Unfortunately, this plant is not native and can be invasive.

‘Sharp’ marshhay cordgrass has great potential for use in gully treatment. Being adapted to Florida coastal dune areas, it is capable of colonizing on dry or wet soils. Its rhizomatous growth habit gives great stability to the soil. It functions well as a sediment filter. This species needed to be planted on more sites, to observe how it performs under a wider spectrum of conditions. Since it is native to Florida, invasion potential is not a serious concern.

‘Northpa’ and ‘Southpa’ bitter panicum came from the same ecosystem as marshhay cordgrass, and function in much the same way. These cultivars showed tremendous potential for use in gully plantings, and merit further study.

Brunswickgrass is closely related to bahiagrass. It has a similar growth habit but is not as aggressive as bahiagrass. It has fair potential for stabilizing the soil in waterways. It appears to be rather short-lived, being easily crowed out by other species. Because of this, it is generally not considered an invasive plant, though it is not native to Florida.

Maidencane is a low growing rhizomatous plant that functions well as a living filter to wetlands. However, because this plant is adapted to wet fertile sites, its usefulness in gullies is questionable. Gullies are generally dry and infertile the majority of the time. This species is known to exist in sandhill habitats in Florida. It may be possible to develop an ecotype that is better adapted to gully conditions. However, limited use and high cultivar development costs may not warrant this.

Limpograss is similar to maidencane in growth habit. It also requires wet fertile conditions to perform well. It did not perform well under the conditions in this study.

Switchgrass is a bunchgrass native to the southeastern US. ‘Alamo’ is a cultivar that originated in Texas but that seems to grow relatively well in Florida. The ‘Defuniak Source’ material used in this study originated in a wetland in Walton County. Neither ecotype performed well in this study. The ‘Defuniak Source’ material apparently needed more moisture to survive. ‘Alamo’ was observed initially but did not persist. This species does not appear to be useful for gully planting under the conditions found in this study.

Lespedeza is a perennial herb with a tall spindly growth habit. Although this was one of the most persistent species studied, its use for gully stabilization is questionable. It has great wildlife food value, however, and may be included in gully plantings for that purpose.

CONCLUSION

The plantings on the four gullies in this study provided a good opportunity to observe the performance of several species. More and more emphasis is being placed on using plant materials which are noninvasive in nature. This study examined several species which fit this criteria, and that also functioned well in limiting gully erosion and downstream sedimentation. The FLPMC staff would like to thank all the NRCS, RC&D and S&WCD members that assisted with planting and monitoring these studies. A video, ‘Vegetative Venture, A Cost Effective Way to Control Gully Erosion in West Florida’, was developed in conjunction with this project. Sponsors were USDA NRCS, Florida Department of Environmental Protection, Yellow River S&WCD, Perdido River S&WCD, Choctawhatchee River S&WCD, Blackwater S&WCD, West Florida RC&D Council, Inc., and the Florida Three Rivers RC& D Council, Inc. We would like to thank all the participating parties for their support and involvement in this study. Copies of the video are available from the NRCS State Office in Gainesville, Florida.

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